12.3.8 v.2

Definition of Terms

A = Total Developmental Area (acres).

Ac = Controlled Developmental Area (acres). This includes that portion of the total developmental area from which storm water is collected and discharged into the detention system.

Au = Uncontrolled Developmental Area (acres). This includes all areas from which storm water is not controlled. A = Ac+Au.

Ai = Total Impervious Area (acres). Impervious portion of A

Ap = Total Pervious Area (acres). Pervious POrtion of A.

Aui = Uncontrolled Impervious Area (acres)

Aup = Uncontrolled Pervious Area (acres)

Ci = Coefficient of runoff for impervious surfaces = 0.9

Cp = Coefficient of runoff for pervious surfaces = 0.2

C = Average coefficient of runoff for total developed area

Cu = Average coefficient of runoff for uncontrolled area

V = Unit volume of detention required (cubic feet per acre)

Vt = Total volume of detention required (cubic feet)

P = Ratio of uncontrolled runoff (Rational Method")

Qr = Unit Discharge Rate (cfs per acre). This varies from 0.2 cfs/acre (when there is no uncontrolled runoff, i.e. P = 0) to 0.1 cfs/acre (when 20% of the runoff is uncontrolled, i.e. P = 0.2).

Qa = Allowable rate of discharge from the detention facility (cubic feet per second)

d = Orifice diameter (inches)

h = Pressure head on orifice. Vertical distance from center of outlet pipe to overflow elevation (feet)

g = Acceleration of gravity = 32.2 ft/sec2

π = pi = 3.14

K = Discharge constant for sharp edge orifice = 0.62

Abbreviations

cfs	cubic feet per second
ft	feet
ft^3	cubic feet
sec	seconds

DETENTION VOLUME COMPS

Detention Volume

1) Determine A, Ai, Ap

A = 22.27 ac
Ai = 13.64 ac
Ap = 5.64 ac

2) Calculate C

$$C = \frac{(.2)(Ap)+(.9)(Ai)}{A}$$

$$C = \frac{(.2)(5.64)+(.9)(13.65)}{22.27}$$

C = 0.60

3) Find V from Table A based on C & 25-yr storm

V = 971 ft^3/ac

4) Calculate Vt

Vt = (V)(A) = 971 x 22.27

Vt = 21,600 ft^3 detention req'd

Orifice Size

1) Determine A, Au, Aui, Aup, Ac

A = 22.27 ac
Au = 3.01 ac
Ac = 19.26 ac
Aui = 2.11 ac
Aup = 0.90 ac

2) Calculate Cu

$$Cu = \frac{(.2)(Aup)+(.9)(Aui)}{Au}$$

$$Cu = \frac{(.2)(.90\ ac)+(.9)(2.11\ ac)}{3.01}$$

$$Cu = 0.69\ ac$$

3) Calculate P

$$P = \frac{CuAu}{CA} = \frac{(0.69)(3.01)}{(.60)(22.27)} = 0.16$$

P < 0.20 ------> system OK

4) Calculate Qv, Qa

$$Qv = .2-(.5)(P)$$
$$= .2-(.5)(.16)$$
$$= 0.12 \text{ cfs/acre controlled}$$

$$Qa = (Qv)(Ac) = (0.12)(19.26) = 2.31 \text{ cfs}$$

5) Summary

----> For 0.2 cfs/acre release rate, req'd storage volume = 21,600 ft^3

----> This assumes restricted outlet, gravity discharge. We will use pumped system; Yrjanaineu & Warren Method results in volume reduction of 10% for 20 acre, 60% impervious site limited to 0.2 cfs/acre discharge. Therefore, approximate volume req'd = 19,440 ft^3

----> If discharge is to 18" dia. public storm sewer, we can discharge 6.9 cfs total, or 0.31 cfs/acre. Approximate volume req'd: .20 * 19,440 = 12,500 ft^3

----> If discharge is to 15" pipe at SE corner property, we are limited to 2.9 cfs total or 0.13 cfs/ac

Approximate Volume req'd = 29,900 ft^3

PIPE LENGTH REQUIRED

Pipe Size	End Area (SF)	If Required to Store V = 12,500 ft³	19,440 ft³	29,900 ft³	
57" x 38"	11.6	1078	16761	2578	
64" x 43"	14.7	851	1323	2034	
77" x 52"	21.9	571	888	1366	
83" x 57"	26.0	481	748	1150	
81" x 59	29.4	426	662	1017	
87" x 63"	32.1	390	606	932	<--
66"	23.8	526	817	1257	